The STRATAFORM Swathmapping Program

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LONG-TERM GOALS:

To provide the fundamental mapping information necessary to support STRATAFORM's multidisciplinary effort to develop a more complete understanding of how short-term oceanographic and geological processes interact to produce the preserved geologic record on the shelf and slope portions of the continental margins..

SCIENTIFIC OBJECTIVES:

The fundamental objective of the STRATAFORM Swathmapping Program is **to provide complete (100%) bathymetric and sidescan imagery coverage of the Northern California and N.J. Margin STRATAFORM field areas**. This has allowed STRATAFORM investigators to evaluate the geologic processes of the shelf and slope over a continuum of scales. Complete coverage also has provided STRATAFORM investigators with the knowledge that their studies are based on a complete picture of morphological relationships rather than the interpolation of sparsely spaced data. In doing this, we have produced a bathymetric, geomorphological, and potentially lithological framework upon which all subsequent work can be built. Ancillary objectives are **to further develop techniques for the remote classification of seafloor materials from swathmapping data** and, **to develop techniques for the interactive 3D visualization of co-registered surficial and subbottom data**.

APPROACH:

We have chosen to use a state-of-the-art multibeam sonar system (EM-1000) for our mapping. As compared to conventional echosounders, multibeam sonars provide increased source level, lateral resolution, and a substantial increase in data density and areal coverage. Most importantly, the newer systems also provide the ability to simultaneously produce high-resolution sidescan sonar imagery. We have developed a full suite of real-time and near real-time multibeam sonar processing tools to assure that only high-quality data is collected and that this data can be processed in the field. These tools also allow for the interactive 3-D visualization of multibeam data sets and derivative products. We are also developing a range of seafloor classification algorithms with particular focus on techniques that look at the characteristics of the returned waveforms as well as the change in backscatter as a function of angle of incidence. The results of these analyses will be compared to ground truth data collected by other STRATAFORM scientists to explore the limits of extracting quantitative seafloor property information from multibeam sonar data.

WORK COMPLETED:

In 1995 and 1996, we completed mapping of the Calif. and most of the N.J. survey areas. In 1997 we completed the remaining deep-water portion of the N.J., processed these data and merged them with the shallow water data. We also processed additional multibeam (Hydrosweep) data from the Eureka area collected by Clark Alexander. We merged this data with the earlier data sets and made the new maps available to all STRATAFORM investigators. We have now focused our efforts on visualization and particularly on the question of remote seafloor classification. We have finalized interactive 3-D fly-throughs of the N. J. margin

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and have developed a suite of automated algorithms for extracting and parameterizing the backscatter as a function of angle of incidence. We have completed a pilot study of the application of these algorithms on a well-ground truthed region of Stellwagen Bank and have now begun applying these algorithms to both STRATAFORM survey areas.

RESULTS:

The combined bathymetry and imagery of the N. J. margin show a spectacular picture of shelf processes with large scale ridge and swale features that appear to be moving across the shelf, a series of ablation features and, a large region near the shelf break that appears to be covered by old iceberg scours. The ridge and swale topography appears to be overriding the scour features though there are several large scour-like feature that also seem to cut into the ridge and swale deposits. If these large features are iceberg scours, this part of the system has been preserved since the last deglaciation. The deep water data provides direct insight into the origin of submarine canyons, with landward erosion apparently the dominant mechanism. Our parameterization of the angular backscatter response curve appears to be a sensitive indicator of changes in seafloor type or texture. In particular, the shape of the curve below 40° is especially revealing as response in the vicinity of the critical angle may be observed. The use of our 3-D visualization tools has allowed us to directly see the spatial distribution of our extracted classifiers and their relationship to seafloor morphology(Fig. 1).

IMPACT/APPLICATIONS:

The swathmapping results from the Eureka and the N. J. margins provide all STRATAFORM investigators with an unprecedented, detailed look at both the bathymetry and distribution of sediments on the shelf and slope. These results have already been used in planning the deployment of a series of long-term moorings, seismic profiling and coring cruises, as well as for planning ROV, submersible work, and ODP sites. Quantitative measurements of slope and sediment-type distributions will inevitably lead to improved models of shelf and slope development, the primary goal of the STRATAFORM program. Our initial results from the New Jersey margin indicate that pervasive ice scouring is evident further south than previously reported and may have impact on our overall understanding of the evolution of shelf stratigraphy.

TRANSITIONS:

Our maps and data have been used by numerous investigators both in and out of STRATAFORM, including several other Navy programs (e.g., SWARM, NRL). Our processing and visualization software is being used by NAVO, NRL, NOAA, USGS as well as several universities and private sector companies.

RELATED PROJECTS: NSERC Chair in Ocean Mapping

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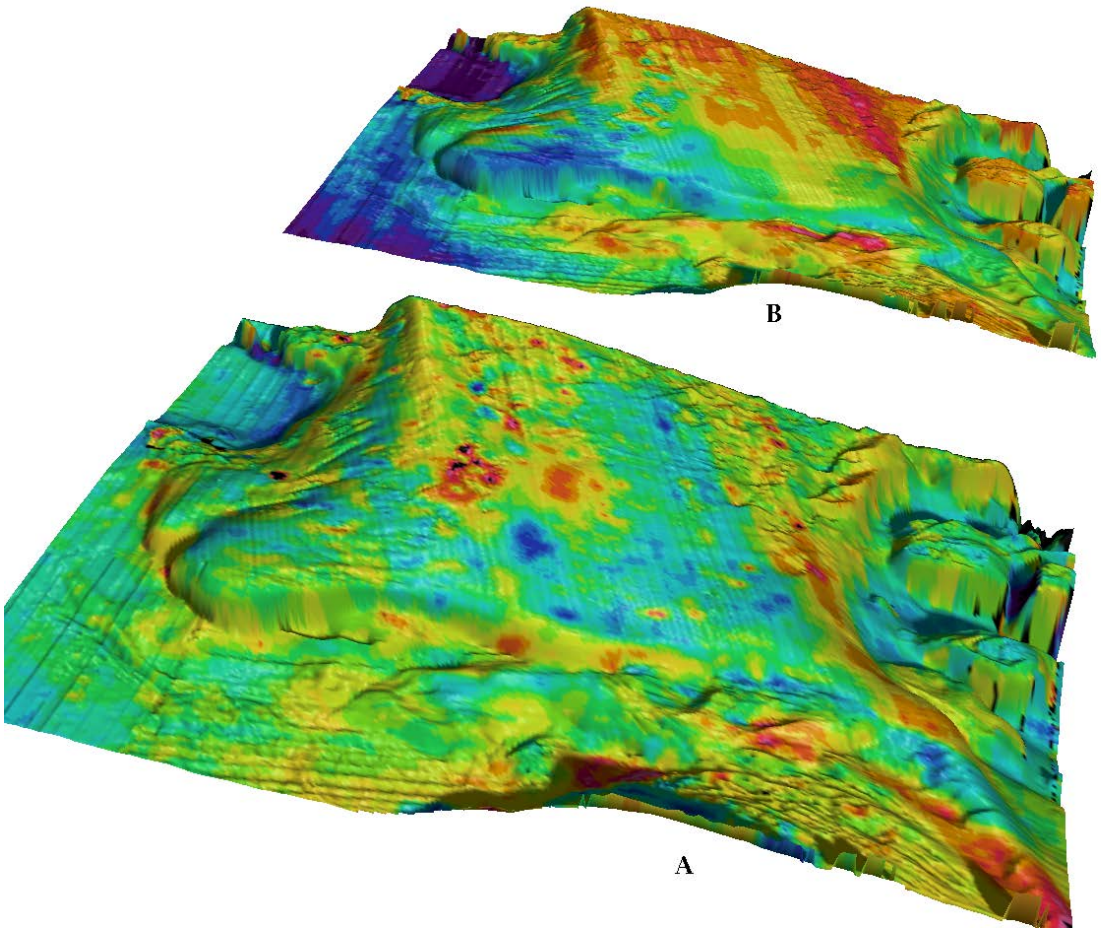

Fig 1. 3-D visualization of two of the twelve parameters extractedfrom the angular response of backscatter data from a 30 x 27 km area of Stellwagen Bank National Marine Sanctuary, Mass. Each is draped over bathymetry and displayed (in original) with color coding. Lower figure (A) represents slope of segment of backscatter curve between 75 and 30 degrees grazing ; upper figure (B) represents mean backscatter between 50 and 40 deg grazing. Parameterization of the backscatter curve may provide important insight into the distribution of seafloor properties; visualization in this mode shows the direct relationship between these parameters and the seafloor morphology